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The effect of aerobic training versus cognitive behavioral therapy in management of anxiety, depression and stress related to COVID 19 pandemic among university students: A randomized controlled trial

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ABSTRACT

Background: The prevalence of anxiety, depression, and stress increased due to COVID 19 crises. Anxiety and depression are the most common psychiatric disorders. The goal of the current study was to compare the effects of aerobic training to cognitive behavioral therapy on university students suffering from mild to moderate anxiety and depression as a result of the Covid 19 pandemic. **Methods:** an online invitation to participate in the study was sent through the university system. Fifty four undergraduate students with mild to moderate anxiety and depression voluntarily participated in this study (mean age: 20.77±1.16) and assigned into two groups; aerobic training aerobic training and cognitive behavioral therapy. The International Physical Activity Questionnaire and the Depression, Anxiety, and Stress Scale were used in an online assessment, performed before and after the treatment. For 8 weeks, an online treatment guide and follow-up were provided, with 5 days per week of AT and one session per week of CBT. **Results:** A significant improvement of DASS scores after treatment in both groups ($p \leq 0.001$). IPAQ scores showed a significant improvement in GA and GB with non-significance in vigorous activities; category. GA showed a significant reduction of anxiety more than GB with a non-significant difference in stress and depression ($p \geq 0.05$). **Conclusions:** In students with mild to moderate anxiety and depression, both AT and CBT are effective in improving manifestations of anxiety, depression, and stress following the COVID-19 pandemic. Aerobic exercise is more effective in treatment of anxiety.

Keywords: Aerobic training-Cognitive behavioral therapy- Anxiety, depression and stress.



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1. INTRODUCTION

Following the World Health Organization's declaration of Corona Virus Disease 2019 (COVID-19) as a pandemic in March 2020 (WHO, 2020), Saudi Arabia took very strong measures to overcome the pandemic. On March 16th 2020, government had switched all university and school teaching-learning process through online platforms. All social, governmental and commercial activities were limited until general lockdown in March 23rd 2020. Due to these dramatic and fearful circumstances especially with the rapid increase in number of fatalities (Barry et al., 2020) a huge increase in the number of people suffering from anxiety, depression and stress worldwide was noticed especially with youth who are unable to socialize and communicate properly with their peers (Salari et al., 2020).

Excessive fear and resulting avoidance are signs of anxiety and mood disorders, which arise in response to a particular object or circumstance in the absence of true threat. Anxiety and depression disorders have the highest overall prevalence rate among psychiatric disorders, with a rate of 28.8 percent in lifetime (Kessler et al., 2005). Untreated anxiety and depression are often a major financial burden, and the functional impairments that accompany them have a significant negative effect on quality of life (DuPonte et al., 1996; Olatunji et al., 2007; Fard et al. 2021). Anxiety and depression disorders in children and adolescents are common, debilitating, and distressing. Furthermore, depression and anxiety often coexist, share a number of etiological causes, and respond to similar treatments (Lewinsohn et al., 1993; Axelson & Birmaher, 2001). Anxiety and depression in adolescents are often linked to somatic symptoms that suggest the need for medical help, such as chronic stomach pain and headaches (Campo et al., 2005). Anxiety and depression in adulthood are commonly linked to poorer health, such as an elevated death rate due to heart attacks (Katon, 2003) and negative health risk habits, such as abnormal sexual activity (Kosunen et al., 2003).

An integrative approach to anxiety and depression treatment, cognitive-behavioral therapy (CBT) is focused on the concept that both cognitive and behavioral mechanisms can alleviate anxiety and depression. While there are differences in these approaches depending on the condition being handled (e.g., separation anxiety, social anxiety, and generalized anxiety disorder), most CBT procedures seek to teach the patient new approach habits, concrete problem-solving skills, and techniques for challenging maladaptive or unreasonable anxious thoughts and beliefs (Brewin, 1996). Cognitive distortions are believed to play a key role in the management of anxiety and depressive thinking since they trigger misinterpretations of environmental risks and impair the patient's coping ability. Behavioral avoidance is also a significant anxiety-maintaining cause. A distressing incident causes avoidant behavior, which is then reinforced by the reduction in distress that occurs after escape. Fear, withdrawal, and catastrophic assumptions are all perpetuated by avoidance.

CBT helps to improve maladaptive thought patterns by stressing the relation between emotions, feelings, and actions, and then teaching new problem-solving and coping strategies. Direct reinforcement, simulation, and in vivo exposures are used in CBT to help patients engage in healthy and adaptive approach behaviors while challenging unhealthy beliefs (Weissman et al., 2008). Exercise is believed to affect mental well-being across a number of proposed mechanisms. Several biological, psychosocial, and psychological models and hypotheses have been suggested as potential explanations for these proposed relationships. Total body warmth (e.g., warm bath) has been shown to relieve muscle tension in studies. Passive heating and high intensity exercise also improved slow wave sleep (relaxation effect), indicating that exercise may be a vehicle for these effects (Horne & Staff, 1983). According to the endorphin hypothesis, the effects of acute exercise on psychological well-being, particularly "euphoria," are caused by the release and subsequent binding of endogenous opioids, specifically β -endorphins, to receptor sites in the brain. Exercise is concluded to serve as a valuable diversion or 'time-out' from stressful stimuli and emotions, and this can contribute to better psychological health, according to the findings. In this regard, patients may find exercise to be a helpful strategy for helping them focus on events other than their specific life circumstances (Daley, 2002).

Many researchers studied the prevalence (Choi et al., 2020; Shevlin et al., 2020; Salari et al., 2020) and predictors (Özdin & Bayrak, 2020) of anxiety and depression due to COVID 19 pandemic among university students (Islam et al., 2020; Rodríguez-Hidalgo et al., 2020) and general population. However, few researches were concerned with the management of these problems especially the comparison between AT and CBT, which is the aim of the current study.

2. PARTICIPANTS AND METHODS

Study design

This is a parallel RCT and double blind study, examining the effect of AT and CBT on university students with mild to moderate anxiety and depression following covid 19 pandemic over a period of 8 weeks. This study was conducted from January till March 2021 from voluntary participants of Taif University students.

Participants

Students were encouraged to participate in the study through an online e-questionnaire using a google form model. All study purposes and procedures were explained in the same platform. Responses from 84 students were collected and analyzed for enrolment in the study. Out of the 84 students who were screened for anxiety and depression, 54 were identified as having mild to moderate anxiety and depression on most days of the week for at least six months, according to the Depression, Anxiety, and Stress Scale (DASS 21) (Culpepper, 2004). While, 12 participants did not meet the inclusion criteria and 10 participants refused to participate. Moreover, eight patients were lost to post treatment analysis four patients on each group. Figure 1 shows the flow of patients through the study. The participants ranged in age between 18 to 25 years ($m = 20.77 \pm 1.16$) years. An e-consent was sent to all study participants who was signed and returned back. Ethical committee of the faculty of applied medical sciences approved this protocol. One day prior to the start of the study procedure, all participants were screened for physical activity in the previous seven days using the International Physical Activity Questionnaires (IPAQ) short form.

Significant psychiatric disorders such as schizophrenia and severe depression, as well as any medical disorder that restricts physical activities, were excluded. Moreover, participants who were taking any anti-anxiety or anti-depressant drugs were also excluded. Participants with any cardiovascular abnormalities that preclude them from undertaking physical exercises or hitting the target heart rate without risk as prescribed by their primary care physician were also omitted. An online instructions and follow up were performed through the university platform. Participants were divided into: group A (GA) ($n=27$) students and they were encouraged to increase their aerobic training of moderate to vigorous exercises such as jumping, running, swimming, pilates or dancing, 5 days/week for one hour daily. Group B (GB) consisted of ($n=27$) students and they received an online CBT sessions (1.5 hour each session) for 8 weeks (once per week).

Sample size calculation

The sample size of 54 subjects was determined using GPower 3.1.9.4 utilizing estimated effect size of 0.39 and Pillai V of 0.1379310 at alpha level 0.05. The power was set at 0.8 with two groups, 8 dependent variables and two measurements (pre and post intervention), so we used MANOVA repeated measure within-between interactions.

Randomization

Both participants and researchers were blinded to the treatment allocation during the randomization process. According to randomized codes, they were assigned to either the AT or CBT groups (ratio 1: 1). Later, random numbers provided by Excel (Microsoft, Redmond, WA, USA) were used to achieve randomization process. This procedure was carried out by an independent examiner who was only given the patients' code numbers. Participants were blinded to group assignment as well as research examiners (i.e. outcome assessors and a physical therapist who prescribed the intervention program).

Assessment

Assessment was constructed and supervised by three well experienced physical therapists with more than 20 years of experience one of them is a neurology and psychiatry specialist. Assessment performed using the following scales:

Primary outcome measure

Depression, Anxiety and Stress scale (DASS 21)

The DASS 21 is a 21-item self-report questionnaire that assesses the severity of a number of symptoms that are typical in anxiety and depression as well as stress. The participant must indicate the existence of a symptom over the previous week when completing the DASS 21. Every item is given a score ranging from 0 (did not apply to me at all in the previous week) to 3 (applied to me a lot or most of the time in the previous week). The DASS 21's main objective is to evaluate the intensity of the core symptoms of anxiety, depression and stress. As a consequence, the DASS 21 can be used not only to determine the severity of a patient's symptoms, but also to assess the patient's reaction to treatment. Validity and reliability of this scale were discussed in several studies (Osman et al., 2012; Ng et al., 2007; Henry & Crawford, 2005; Nieuwenhuijsen et al., 2003).

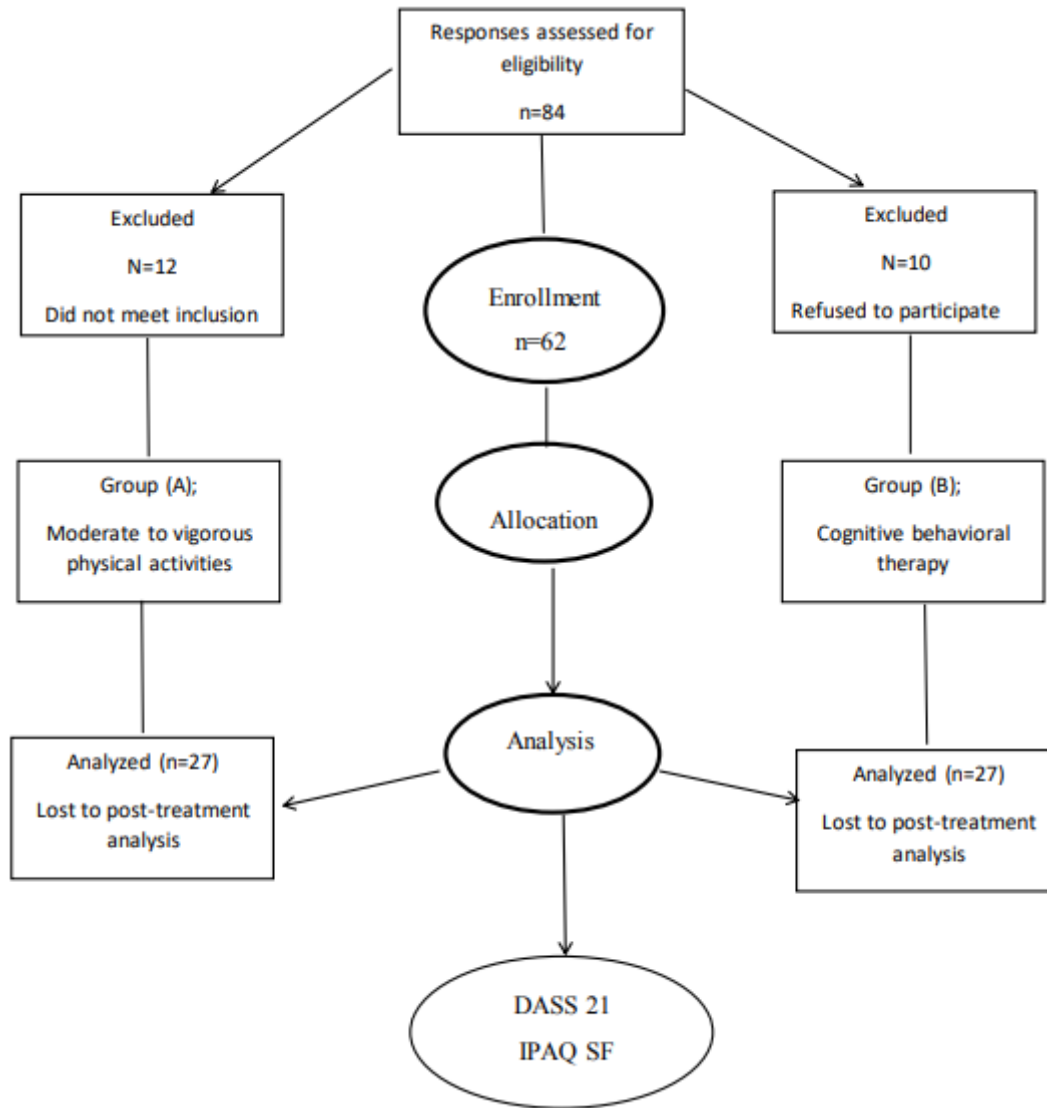


Figure 1 Flow chart of the study participants. DASS 21, depression, anxiety and stress scale; IPAQ SF, international physical activity questionnaire, short form

Secondary outcome measure

International Physical Activity Questionnaires short form (IPAQ)

The International Physical Activity Questionnaires short form (IPAQ) was created and validated for use in adults (ages 15 to 69), not children or the elderly (Medina et al., 2013; Pedišić et al., 2011; Booth et al., 2003). The self-administered short form questionnaire consists of seven questions about the type of physical activity and the time spent being physically active in the previous seven days. The questionnaires' aim is to establish standardized instruments that can be used to collect data on health-related physical activity that can be compared internationally.

Scoring IPAQ

There are two types of scoring the IPAQ results which are:

Continuous scoring

IPAQ data may be recorded in a continuous measure format. Weighting each form of activity by its energy requirements specified in METs to produce a score in MET-minutes can be used to quantify one measure of volume of activity "vigorous, moderate, and walking."

METs are multiples of resting metabolic rates, and a MET-minute is calculated by multiplying an activity's MET score by the number of minutes completed. The following equation can be used to calculate kilocalories from MET-minutes: (weight in

kilograms/60 kilograms) MET-min MET-minutes/day or MET-minutes/week may be used, although the latter is preferred since it is more widely used. In our study we calculated METs/week (IPAQ, 2016).

Categorical scoring

It is either inactive, minimally active or HEPA active which is an abbreviation to health enhancing physical activity (high active category) (IPAQ, 2016).

Intervention

Aerobic training (AT)

Patients in group (A) were advised to engage in one hour of daily moderate to vigorous physical activity at 70% to 90% of their maximum heart rate, which was estimated using this formula ($HR_{max} = 220 - age$) (Carek et al., 2011; Hovland et al., 2013).

Heart rate was recorded using heart rate monitor watch (Polar FT4 heart rate and calorie monitor with chest strap) produced by Polar Electro Oy/Polar Electro Inc. Canada. The device was pre-set to alarm on the target heart rate. An online instructions were sent to all participants. A follow up sessions were performed once a week to monitor and answer any questions, however a 24/7 online messaging were conducted to answer any questions or updates from the participants. Aerobic training performed was tread mill running, high pace stationary cycling or weight bearing aerobic exercises. The duration of treatment is 8 weeks with 5 times /week of exercise (Dunn et al., 2005). Participants were instructed to perform simple stretches at the beginning of the exercises protocol as well as warming up and cooling down periods within the physical activities regime as 10 minutes each at starting and ending of the exercises protocol making the whole time of exercise session 80 minutes.

Cognitive behavioral therapy (CBT)

Patients of GB received on online sessions of CBT, once a week for 8 weeks. According to the CBT session structure provided by Cully and Teten (Cully & Teten, 2008), the program was held on a weekly basis over 8 consecutive weeks within a group CBT sessions and each session lasted approximately 1.5 hour (table 1). The main aim of CBT, according to many previous researches, is to help patients develop a greater tolerance for uncertainty in their daily lives (Ghanem et al., 2011; Whitfield, 2010; Dugas & Robichaud, 2007; Morgan et al., 2013; Talwar et al. 2021). An initial evaluation (mood check), setting an agenda for the treatment session, an update from the previous session, reviewing homework, debating agenda items, summarizing the session material, assigning homework, and finally getting patients' feedback about the session were all elements of a CBT session. The final session focused on a review of what the patients had learned and what they wanted to do more of in the future. For the patient's ease, a maintenance program should be written down. It was explored how to practice cognitive restructuring strategies, how to keep exposure sessions going, and how to establish the idea of a self-therapist.

Table 1 Cognitive behavioral therapy sessions structure according to Cully and Teten suggestions with modifications (Cully & Teten, 2008).

	Session contents	Explanations
Session No 1	<ul style="list-style-type: none"> - Introduce the patient to CBT. - Assess the patient's needs - Create an initial treatment plan and set goals. 	Conceptualization of the case: - Gain a thorough understanding of the patient and his problems. - Explain treatment technique - Serve as a baseline for evaluating the patient's changes and progress. It also helps patients build rapport and a sense of hope.
Session No 2	<ul style="list-style-type: none"> -Evaluate the patient's concerns. -Make a list of your initial objectives. 	The same as session 1
Session No 3	<ul style="list-style-type: none"> - Begin intervention techniques 	Identifying Maladaptive Thoughts, Challenging maladaptive thoughts and believes. -Behavioral activation: can help to boost mood in a variety of ways, including: 1-increasing physical activity, 2- reversing avoidance, 3- improving one's self-esteem and, 4- enhancing feelings of value and importance

		- Problem Solving: can assist in both realistic problem solving and emotion-focused coping (e.g., increasing control, decreasing stress, and increasing hopefulness) Relaxation: Muscle relaxation and/or deep breathing and/or guided imagery. Homework: Applying all learned skills and strategies at home. Mood check.
Session No 4	- Continue re-evaluate intervention Techniques, Objectives/Treatment Plan	The same as session 1 and Session 3
Session No 5	- Continue/ refine intervention techniques.	The same as session3
Session No 6	- Continue/ refine intervention techniques	The same as session 3
Session No 7	- Continue using intervention techniques as needed. - Talk about how you're going to end your treatment and how you're going to keep the changes you've made.	Ending treatment and maintaining changes: require a review of skills learned through treatment, as well as the expression and resolution of concerns about functioning in real life.
Session No 8	-Stop the procedure and assist patients in maintaining their new changes.	The same as session 7

Statistical analysis

To compare subject characteristics between groups, descriptive statistics and an unpaired t-test were used. The Chi-squared test was used to compare sex between groups. The Shapiro-Wilk test was used to ensure that the data had a normal distribution. To ensure group homogeneity, Levene's test for variance homogeneity was performed. Mixed- design MANOVA was used to compare between and within groups A and B. For subsequent multiple comparisons, post-hoc tests with the Bonferroni correction were performed. For all statistical tests, the level of significance was set at $p \leq 0.05$. The statistical package for social sciences (SPSS) version 25 for Windows was used for all statistical analysis (IBM SPSS, Chicago, IL, USA).

3. RESULTS

Subject characteristics

There was no significant difference between both groups in the mean age, BMI and sex distribution ($p \geq 0.05$) (Table 2). Out of 84 responses that were assessed for eligibility, 12 participants (14.3%) did not meet the inclusion criteria and 10 participants (11.9%) refused to participate. Eight patients (9.5%) were lost to post treatment analysis four patients on each group. Figure 1 shows the flow of patients through the study. Patients were randomized into two groups: group (A) (GA) study group (n=27) and group (B) (GB) control group (n=27).

Table 2 Comparison of subject characteristics between group A and B

	Mean \pm SD		p-value
	Group A N=27	Group B N=27	
Age (years)	20.92 \pm 1.1	20.63 \pm 1.21	0.35
BMI (kg/m ²)	22.82 \pm 4.94	23.11 \pm 4.56	0.82
Sex			
Females	18 (67%)	20 (74%)	0.55
Males	9 (33%)	7 (26%)	

SD: standard deviation; p value: probability value

Effect of treatment and time on DASS 21 and IPAQ

There was a significant interaction between time and treatment using mixed MANOVA (Wilks' Lambda = 0.02, $F(8, 45) = 190.73$, $p = 0.001$). There was a significant main effect of treatment (Wilks' Lambda = 0.07, $F(8, 45) = 66.2$, $p = 0.001$). There was a significant main effect of time (Wilks' Lambda = 0.01, $F(8, 45) = 315.5$, $p = 0.001$).

Within group comparison

Concerning Primary outcome measure: DASS 21 results, a significant reduction in depression, anxiety and stress in both groups A and B were observed post treatment compared with that pre-treatment ($p \leq 0.001$). While IPAQ (Secondary outcome measure) results showed a significant increase in continuous "vigorous activities, moderate activities, walking scores and METs" as well as categorial scores in GA after intervention compared with before intervention ($p \leq 0.001$). In GB, there was a significant increase in moderate activities, walking and METs after intervention compared to before intervention ($p \leq 0.001$) while there was no significant change in vigorous activities and category ($p \leq 0.05$) (table 3 & 4; figure 2).

Table 3 Mean stress, anxiety and depression "DASS scores" pre and post treatment of the group A and B

	GA (n=27)	GB (n=27)	
	Mean \pm SD	Mean \pm SD	p value
Stress			
Pre	2.92 \pm 0.67	2.88 \pm 0.75	0.85
Post	1.29 \pm 0.46	1.33 \pm 0.55	0.79
	$p = 0.001$	$p = 0.001$	
Anxiety			
Pre	3.07 \pm 0.72	3.03 \pm 0.64	0.84
Post	1.33 \pm 0.48	1.92 \pm 0.55	0.001
	$p = 0.001$	$p = 0.001$	
Depression			
Pre	2.7 \pm 0.66	2.81 \pm 0.68	0.54
Post	1.44 \pm 0.57	1.62 \pm 0.74	0.31
	$p = 0.001$	$p = 0.001$	

GA: group A, GB, group B, DASS: depression, anxiety, stress; SD, Standard deviation; p value, Probability value.

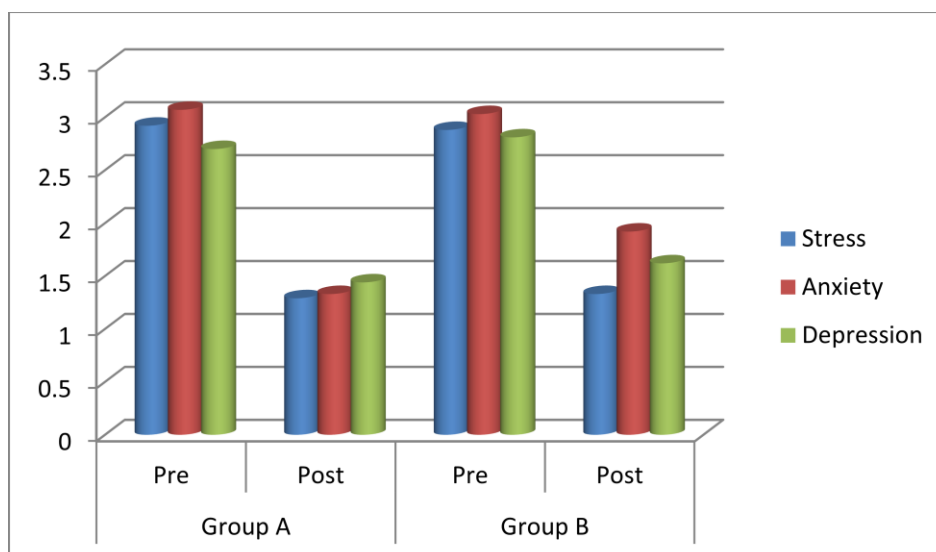


Figure 2 Mean stress, anxiety and depression "DASS scores" pre and post treatment of the group A and B

Between groups' comparison

Before intervention comparison showed no significant difference between groups in all variables ($p \geq 0.05$). Concerning DASS 21 scores, there was a significant decrease in anxiety of GA compared to GB after intervention ($p \leq 0.001$). While, there was no significant difference in stress and depression between groups after intervention ($p \geq 0.05$). Regarding IPAQ scores, there was a significant increase in continues “vigorous activities, moderate activities and walking scores and METs” and categorical scores in the GA compared to GB after intervention in relation to before ($p \leq 0.001$) (table 3 & 4; figure 3 & 4).

Table 4 Mean “IPAQ” continuous scores and categorical scores pre and post treatment of the group A and B

	GA (n=27)	GB (n=27)	p value
	Mean \pm SD	Mean \pm SD	
Continuous activities:			
- Vigorous			
Pre	390.6 \pm 79.16	416.66 \pm 75.95	0.22
Post	1033.85 \pm 129.67	449.25 \pm 95.1	0.001
	$p = 0.001$	$p = 0.13$	
- Moderate			
Pre	344.44 \pm 75.15	355.55 \pm 81.63	0.6
Post	1030.37 \pm 169.66	416.29 \pm 113.44	0.001
	$p = 0.001$	$p = 0.01$	
- Walking			
Pre	1103.22 \pm 198.64	1062.03 \pm 178.34	0.42
Post	1617.29 \pm 214.28	1161.37 \pm 196.19	0.001
	$p = 0.001$	$p = 0.008$	
- METs			
Pre	2213.25 \pm 285.42	2182 \pm 291.9	0.7
Post	3975.55 \pm 273.33	2576.4 \pm 265.26	0.001
	$p = 0.001$	$p = 0.04$	
Category			
Pre	1.92 \pm 0.38	1.96 \pm 0.33	0.71
Post	2.74 \pm 0.44	2.11 \pm 0.5	0.001
	$p = 0.001$	$p = 0.19$	

GA: group A, GB, group B, IPAQ: International Physical Activity Questionnaires, SD: Standard deviation, p value: Probability value

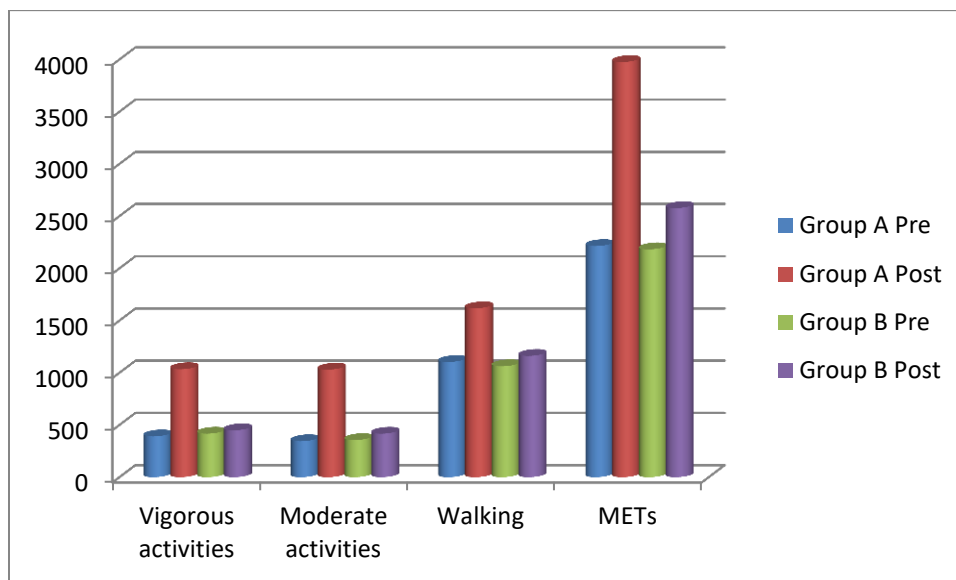


Figure 3 Mean “IPAQ” continuous scores pre and post treatment of group A and B

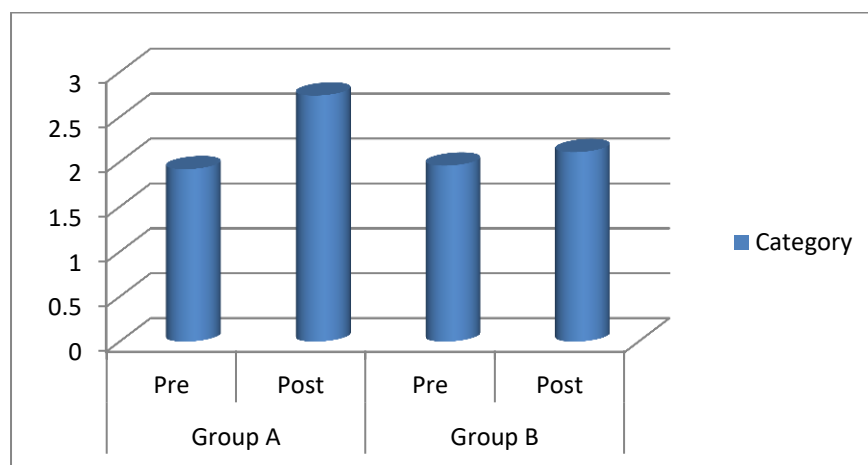


Figure 4 Mean “IPAQ” categorical scores pre and post treatment of group A and B

4. DISCUSSION

The purpose of this randomized controlled trial (RCT) was to compare the effect of aerobic training versus cognitive behavioral therapy among university students with mild and moderate degrees of anxiety and depression following COVID 19 pandemic. After 8 weeks of intervention, both groups showed a significant improvement from before to after intervention results in Primary outcome measure “DASS2” (stress, anxiety and depression). Aerobic training had a significant improvement in secondary outcome measure “IPAQ” scores, while CBT had a significant increase in moderate exercise, walking and MET but not vigorous exercise and categorical scores. Also aerobic training reduced anxiety more than CBT; however both types of treatments had a non-significant effect on depression and stress. As far as we know, there is no study discussing the comparison between AT and CBT among university students following COVID 19 pandemic. So, our discussion will be limited to the partially similar studies in normal circumstances before COVID 19 pandemic.

To our knowledge there are few studies discussing the comparison between AT and CBT in the treatment of anxiety and depression among university students. The first study conducted in 1999 by McEntee & Halgin, who compared the effect of CBT and AT in the management of anxiety only in undergraduate students using State-Trait Anxiety Inventory (STAI). Participants were subdivided into 4 equal groups (AT, CBT, AT and CBT; control). There results showed that all groups were equally effective in reducing anxiety when compared to no treatment. The difference between the previous study and ours is the procedures itself. In the previous study treatment was conducted for 6 weeks compared to 8 weeks in ours and the duration of exercises was 20 minutes only. The duration of aerobic training was much less than our study which was 80 minutes. This brings out the dose effect of exercises. Also, Hovland et al., (2013) found that both CBT and physical exercise showed improvement in management of anxiety

and panic disorder however CBT is more effective than physical exercise as treatment of anxiety and panic disorder. The difference could be postulated to the frequency and the intensity of physical exercises where Holand study reported frequency of only 3 times per week; however in our study it was 5 times per week. Moreover, in our study we stressed the dose effect of exercises which should be with moderate to vigorous intensities, but in Hovland study exercises were mild to moderate only. Dose effect was discussed in Morgan et al., (2013), the author concluded that, individuals can exercise for at least 30 minutes, three days a week, at a moderate-to-vigorous intensity for at least eight weeks as minimum guidelines for mental health benefits.

Dunn et al., (2005) examined the dose-response relationship between exercise and depressive symptom reduction in patients with anxiety and depression who exercised alone. They discovered that those who exercised five days a week with a weekly energy expenditure of 17.5 kcal/kg/week (moderate to vigorous intensities) had substantially lower levels of depression than those who exercised with a low intensity and a weekly energy expenditure of 7 kcal/kg/week. The latter regimen produced results that were equivalent to those of a placebo with stretching and flexibility exercises. Hallgren et al., (2015) conducted an RCT to compare the efficacy of exercise, internet-based CBT and standard treatment of counseling and medications, on patients with depression. They concluded that exercise and internet-based CBT were found to be more successful than traditional care by a general practitioner, and both are promising non-stigmatizing treatment options for patients with mild to moderate anxiety and depression. Another comparative study is between CBT and AT in treatment of depression only among students. This study was conducted by Sadeghi and et al., (2016) who found out that CBT reduced depression more than AT but it was a non-significant improvement. All McEntee & Halgin, (1999); Hallgren et al., (2015); Sadeghi et al., (2016) studies compared the effect of CBT and AT, however McEntee studied its comparison on anxiety only, Hallergan and Sadeghi on depression only. Contrary to our study, this compared its effects on anxiety, depression as well as stress. Most of the previous studies results are in accordance with our study results where we found both CBT and AT were effective in reducing anxiety, depression and stress; however exercise were superior in reducing anxiety more than CBT.

Physical exercises effects on anxiety and depression have been discussed in many studies, especially during COVID 19 pandemic. Due to quarantine, isolation and limited activities, the development of depression, anxiety consequently stress has been found to increase in general population (Choi et al., 2020; Shevlin et al., 2020; Salari et al., 2020; Özdin & Bayrak, 2020; Islam et al., 2020; Rodríguez-Hidalgo et al., 2020). Effects of exercise on mental health were discussed even before COVID 19 pandemic in many researches. Ströhle et al., (2007) studied 2,548 adolescents and young adults. The researcher concluded that regular aerobic training lowered the incidence of comorbid mental disorders especially somatoform, dysthymic and some anxiety disorders after 4 years follow up. The same suggestion was proposed by Martinsen, (2008) who concluded that there is great evidence that physical exercises have a preventive and therapeutic effect on people suffering from anxiety and depression. He also stated that there is a strong link between sedentary lifestyles and depression in both men and women. The effect of exercise on anxiety and depression during COVID 19 has been discussed in many researches. Hu et al., (2020) suggested that 20 minutes per session, 2 times per week of extreme to moderate exercise may reduce anxiety in healthy persons. While relaxation and breathing exercises were prescribed for post COVID 19 patients. Zhang et al., (2020) also confirm the same finding of the previous study. The author suggested a total of 2500 METS of exercise per week is sufficient to decrease the effect of anxiety and depression among students during COVID 19 pandemic.

The mechanisms underlying, mediating, and/or moderating exercise-related improvements in depression and anxiety disorders are most likely a complex interaction of psychological and neurobiological mechanisms. Ströhle, (2007) discussed the model explaining the antidepressant and anxiolytic activity of exercise. The author proposed that the therapeutic effects of exercise training include a number of psychological factors such as: The therapeutic efficacy of exercise training appears to involve increased self-efficacy, a sense of mastery, distraction, and changes in self-concept. Exercise training can also be used as an exposure therapy for panic disorder. Furthermore, biological pathways such as increased central norepinephrine neurotransmission, changes in the hypothalamic adrenocortical system, and increased secretion of atrial natriuretic peptide, amine metabolites, serotonin synthesis and metabolism, and β -endorphins are proposed. Exercises can also increase body temperature, blood circulation to the brain, and have an effect on the hypothalamic-pituitary-adrenal axis, reducing anxiety and stress reactivity, as well as endorphin monoamine theory, which is equivalent to relaxation strategies (Kaur et al., 2013). A study by Pavón et al., (2020) examined the effect of physical activities as a therapy to fight against mental and physical health during COVID 19 especially in elderly. The authors suggested that physical activities especially outdoors are an easy and cost-effective method of prevention and treatment of mental and physical health. In a study conducted about the effect of exercises on brain functions during COVID 19 outbreak by De Sousa et al., (2021) the author reported that regular physical exercise can reduce the risk for stroke which is more possible in patients with previous COVID 19 infections. The author also added that regular physical exercises improve brain health by improving neurogenesis, angiogenesis and synaptogenesis which is a result of neurotrophins and growth factors.

The results of our study support all of the mentioned previous research studies where we found an improvement of all the measured data except for vigorous and categorical scoring of the IPAQ for the CBT group. We suggest that these results may be due to the difficulty in exercising in a vigorous intensity after being in a sedentary life, so moderate and walking are rather more realistic goal to start with. However if we could do a follow up study, these kind of exercises may be would be of a higher intensity. As regard categorical scoring, the fact that categorical scoring is a more subjective type of questionnaire make it possible to be subjected to human subjectivity. The effect of CBT has been studied before the outbreak of COVID 19. In 2011 Seligman & Ollendick, (2011) reported that there isa significant evidence to support the efficacy of CBT for treatment of youth anxiety and depression. CBT is consistent with an evidence-based medicine perspective that values empirically validated problem-focused interventions, unlike most psychotherapeutic approaches that have been used to treat these conditions. CBT provides a logical theoretical structure to direct clinicians through an individual evaluation of particular problem domains, the implementation of problem-specific treatment approaches, and the monitoring of treatment progress using well-defined outcomes. CBT, on the other hand, is not an easy process; it necessitates ongoing instruction by parents and trained assistants in order to improve the youth's habits. Many clinical experts already conclude that CBT, when provided through an evidence-based, multimodal, multidisciplinary practice model, is the best psychotherapeutic therapy for children and adolescents with a variety of anxiety and depressive disorders (De Sousa et al., 2021; Seligman & Ollendick, 2011; Compton et al., 2004; Reinecke et al., 2003).

As regards COVID 19 pandemic, the effect of CBT on anxiety depression and stress has been discussed in few researches. Li et al., (2020) examined the effect of CBT on COVID 19 patients compared to controls. Using a Chinese version of DASS 21 over a nighty three participants, the researchers found a significant reduction of measurements in both groups with a higher reduction in CBT group. However, the longer the hospital stays, the greater the anxiety levels (Li et al., 2020). Weiner et al., (2020) discussed the effect of online CBT on management of stress in healthcare workers during COVID 19 pandemic. The authors used perceived stress scale (PSS-10) and the patient Healthcare Questionnaire (PHQ-2) as primary out come as well as other secondary outcomes on 120 healthcare workers that were randomly assigned into a CBT group and a bibliotherapy group. A seven video sessions with 20 minutes each were broadcast to the CBT group in each week with a 24/7 online counselling. Bibliotherapy group are able to download psycho education materials (brochures) which contain written and illustrated instructions to guide relaxation and mindfulness. Both groups are allowed to call a psychological hotline throughout the study. After 8 weeks of intervention the authors concluded that CBT program significantly reduces stress and prevent severe psychiatric disorders as depression compared to control group.

In our research, anxiety was improved in AT group higher than CBT group on the contrary to depression and stress which has no significant difference. One potential explanation for the lack of a significant change in depression and stress scores is that the CBT program involves behavioral changes in terms of physical activities, such as increasing the amount of physical activity without a measured value. Moreover, relaxation techniques included in the CBT program provide effects similar to physical exercises as discussed earlier in the discussion. This is obvious regarding the significant within group improvement of continuous scoring (METs) in the CBT group which means that the participants did increased their physical activities according to the CBT instructions.

Limitations

This study was limited to the small number of participants as this is a small university with small number of students. Also the inability to perform a follow up measurements as most of our participants did not want to undergo more questionnaires in the future; hence it was difficult to continue the follow up with a small number of participants. Another limitation was few numbers of randomized controlled studies concerning the comparison between physical exercises therapy and CBT during COVID 19 pandemic which make it difficult to compare between results.

5. CONCLUSION

In our study, we conclude that both AT and CBT are effective in improving complications of anxiety, depression and stress among university student with mild to moderate anxiety and depression followed COVID 19 pandemic. However, when compared to CBT, AT has been shown to be more effective in the management of anxiety than depression and stress. So, aerobic training is considered more affordable, easy to perform during the lockdown and has other health benefits especially on the cardiopulmonary status which we recommend to be the first line of treatment. On the other hand CBT is expensive and needs consultation but it has a long-time effect on anxiety and depression.

Recommendations

Further research is needed with more intervention time and larger sample number. Considering the positive effect of both aerobic training therapy and CPT proved by our research, a combination trial to study the effect of both aerobic training and CBT, is mandatory which could be more effective in managing anxiety and depression manifestations.

Authors' contribution

Dr. Nashwa S Hamed, PH. D: Conceptualization, Project Administration, Writing – Original draft Preparation

Dr. Amr A Abdel-aziem: Investigation, Supervision, Writing – Review & Editing

Dr. Alsufiany Muhsen B.: Funding Acquisition, Data Curation, Software

Dr. Marwa M Eid: Methodology, Data Curation, Visualization

Dr. Hatem A Allam: Supervision, Visualization, Review & Editing

Dr. Amira M. El-Gendy: Methodology, Data Curation, Initial Editing.

Dr. Lamiaa K El Sayyad: Data Curation, Formal Analysis, Validation

Ethical Approval

The study was approved by the college of Applied medical Sciences Ethical Committee, Taif University (ethical approval code: 42-0037). Clinical Trials.gov Identifier: NCT04662021.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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Data and materials availability

All data associated with this study are present in the paper.

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